Q.1
Suppose that 60 students are enrolled in a physics class and following are the test score received by them:

77, 44, 49, 33, 39, 76, 55, 68, 39, 44, 59, 36, 55, 47, 61, 53, 32, 65, 51, 29, 41, 32, 45, 83, 58, 73, 47, 40, 26, 59, 43, 66, 61, 44, 25, 39, 72, 37, 55, 34, 47, 66, 53, 83, 58, 73, 47, 40, 77, 45, 62, 45, 45, 36, 78, 48, 54, 50, 51, 66.

Construct a frequency distribution with suitable class interval by exclusive and inclusive method.

<u>Solution:</u> Here, $n = 60$

Lowest value $= 25$

Highest value $= 83$

$\therefore$ Range $= 83 - 25$
$= 58$

$$\text{No. of classes, } K = 1 + 3.322 \log_{10} n$$
$$= 1 + 3.322 \log_{10} 60$$
$$= 1 + 3.322 \times 1.778$$
$$= 6.91$$
$$\simeq 7$$

$$\therefore \text{Class interval} = \frac{\text{Range}}{\text{No. of classes}}$$
$$= \frac{58}{7}$$
$$= 8.29$$
$$\simeq 9$$

Scanned by CamScanner

Exclusive method :

The classes will be 25-34, 34-43, 43-52, ...

Inclusive method :

The classes will be 25-33, 34-42, 43-51, ...

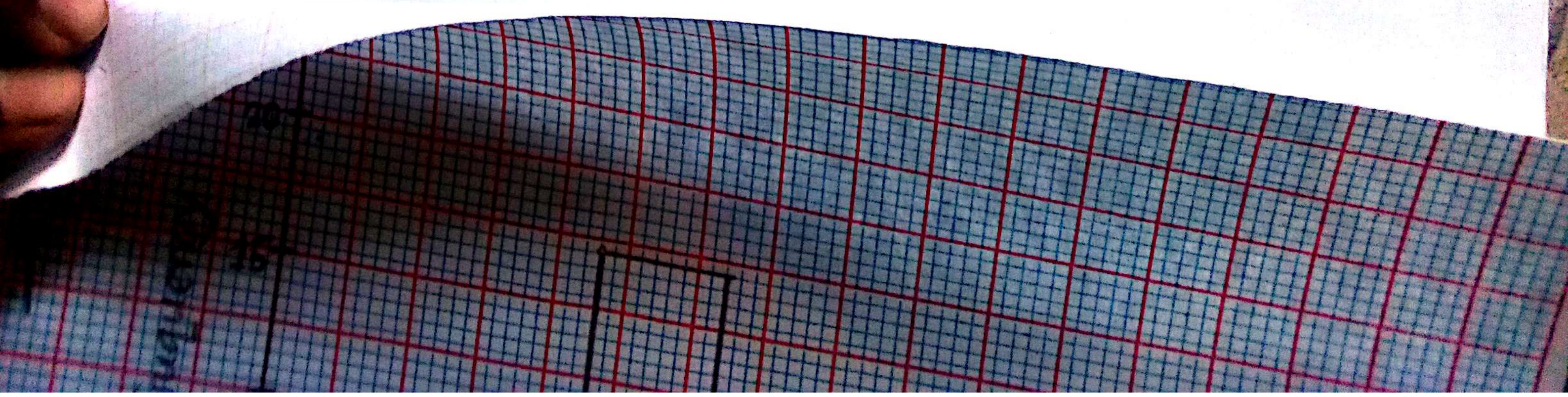
Frequency distribution table :

Class interval		Tally marks	Frequency
Exclusive method	Inclusive method		
25-34	25-33	$\cancel{||||}$ /	6
34-43	34-42	$\cancel{||||}$ $\cancel{||||}$	10
43-52	43-51	$\cancel{||||}$ $\cancel{||||}$ $\cancel{||||}$ //	17
52-61	52-60	$\cancel{||||}$ $\cancel{||||}$	10
61-70	61-69	$\cancel{||||}$ ///	8
70-79	70-78	$\cancel{||||}$ //	7
79-88	79-87	//	2
			n = 60

(i) Draw histogram, frequency polygon and ogive curve from the frequency table

<u>solution:</u> Table for constructing graphs:

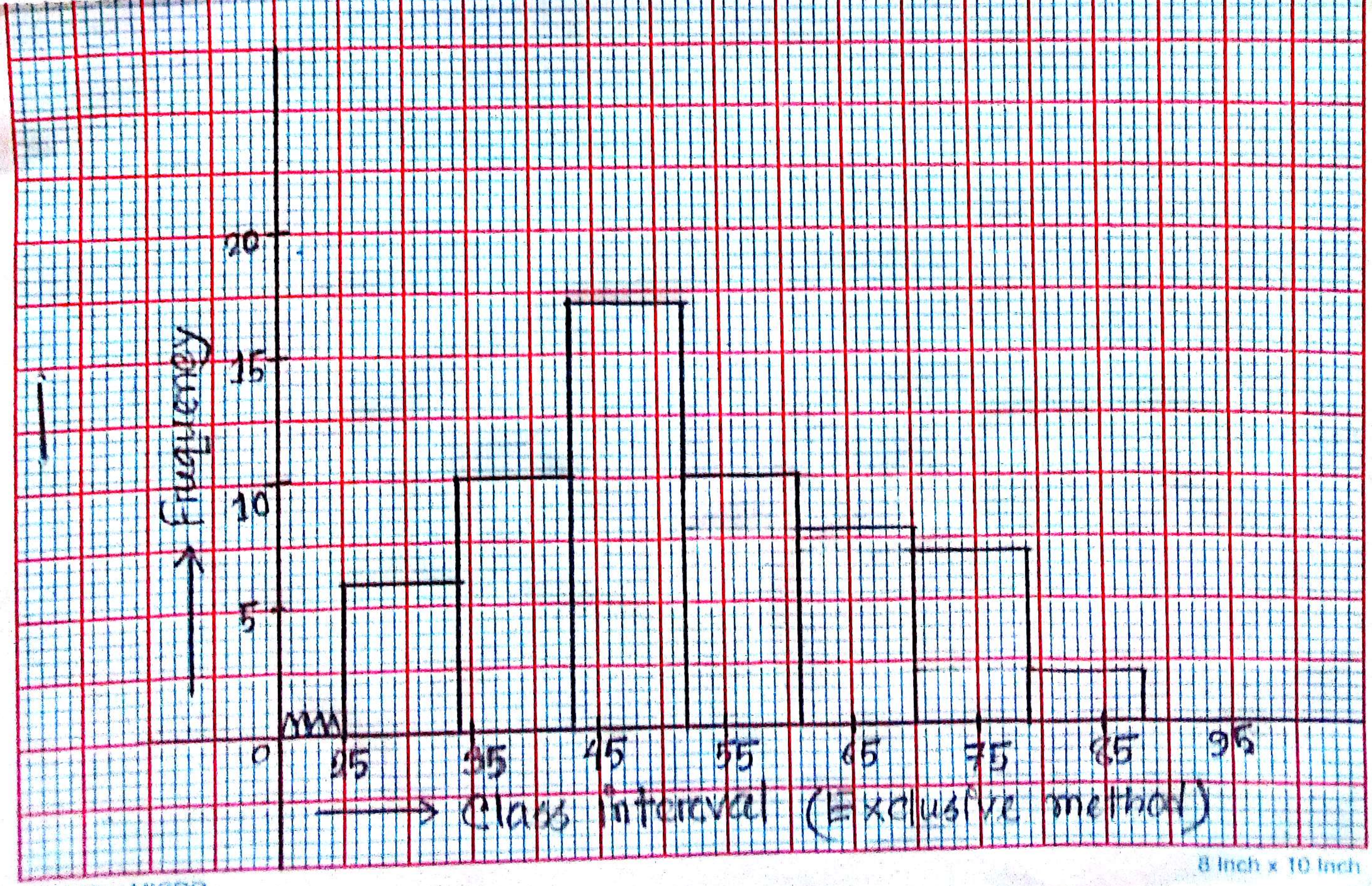
Class interval		Frequency	Cumulative frequency	
Exclusive method	Inclusive method		Upper class interval	Lower class interval
25 - 34	25 - 33	6	60	6
34 - 43	34 - 42	10	54	16
43 - 52	43 - 51	17	44	33
52 - 61	52 - 60	10	27	43
61 - 70	61 - 69	8	17	51
70 - 79	70 - 78	7	9	58
79 - 88	79 - 87	2	2	60
		$n = 60$		



(i) Draw histogram, frequency polygon and ogive curve from the frequency table.

<u>Solution</u>: Table for constructing graphs:

Class interval		Frequency	Cumulative frequency	
Exclusive method	Inclusive method		Upper class interval	Lower class interval
25 – 34	25 – 33	6	60	6
34 – 43	34 – 42	10	54	16
43 – 52	43 – 51	17	44	33
52 – 61	52 – 60	10	27	43
61 – 70	61 – 69	8	17	51
70 – 79	70 – 78	7	9	58
79 – 88	79 – 87	2	2	60



Now the class interval (C.I) are plotted along x axis and corresponding frequency are plotted along y axis and construct adjacent rectangle and then calculate the mid points of each bar. After that the mid-points are plotted in the graph classes of zero frequency are added at each middle end of the frequency distribution. The frequency polygon is obtained by joining all the points by straight lines.

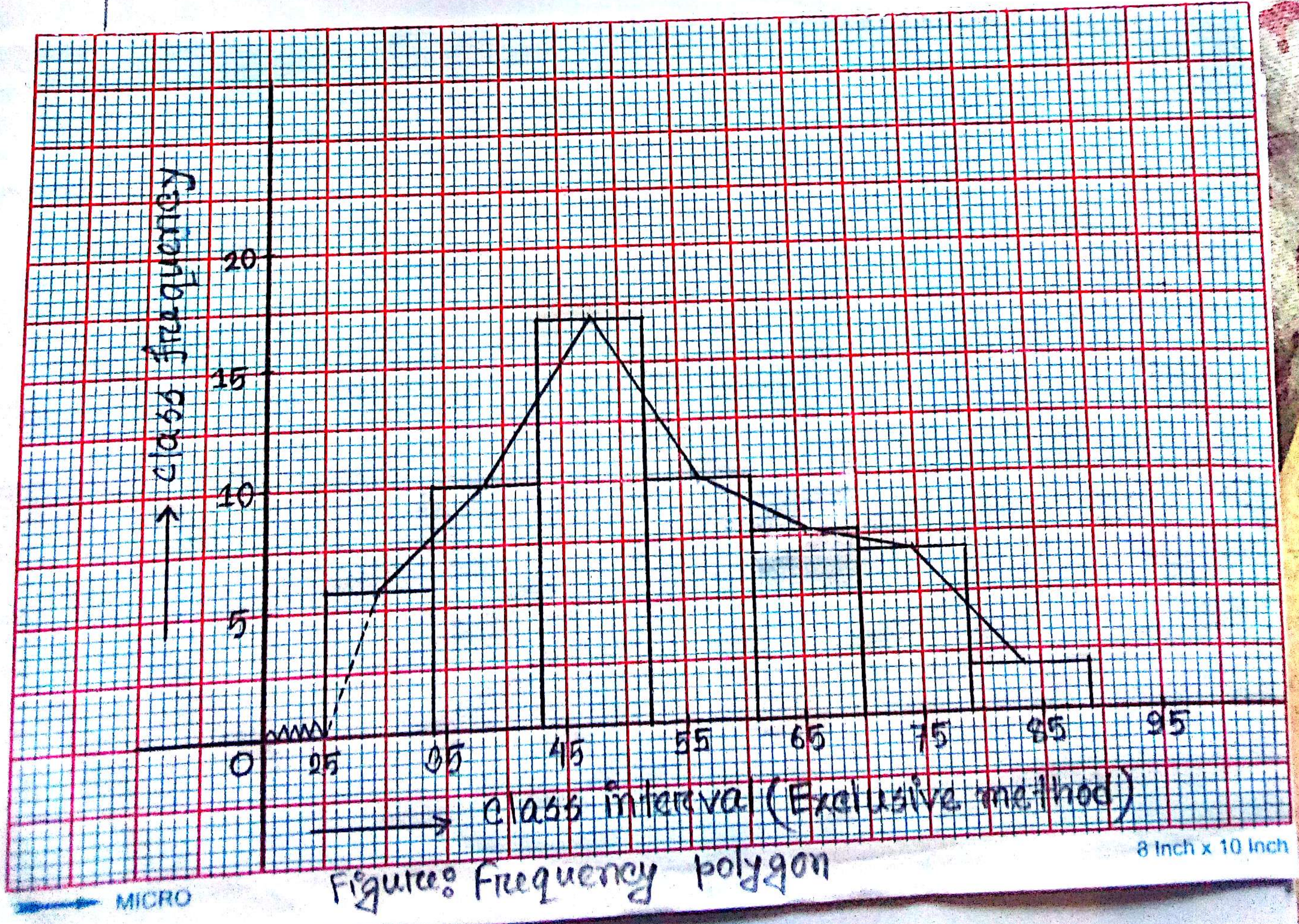


Figure: Frequency polygon

Scanned by CamScanner

Ogive Curve:

In this case, upper or lower class boundaries are plotted along x axis and less than or more than cumulative frequency are plotted along y axis. The cumulative frequency curve or ogive curve is obtained by joining all the points by a straight line.

Figure: Less than ogive

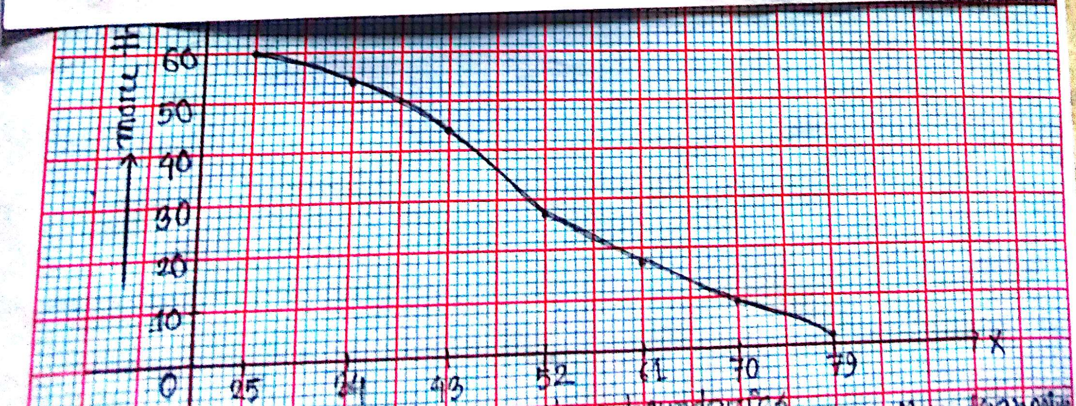


Figure: More than ogive

x axis and less than or more than cumulative frequency are plotted along y axis. The cumulative frequency curve or ogive curve is obtained by joining all the points by a straight line.

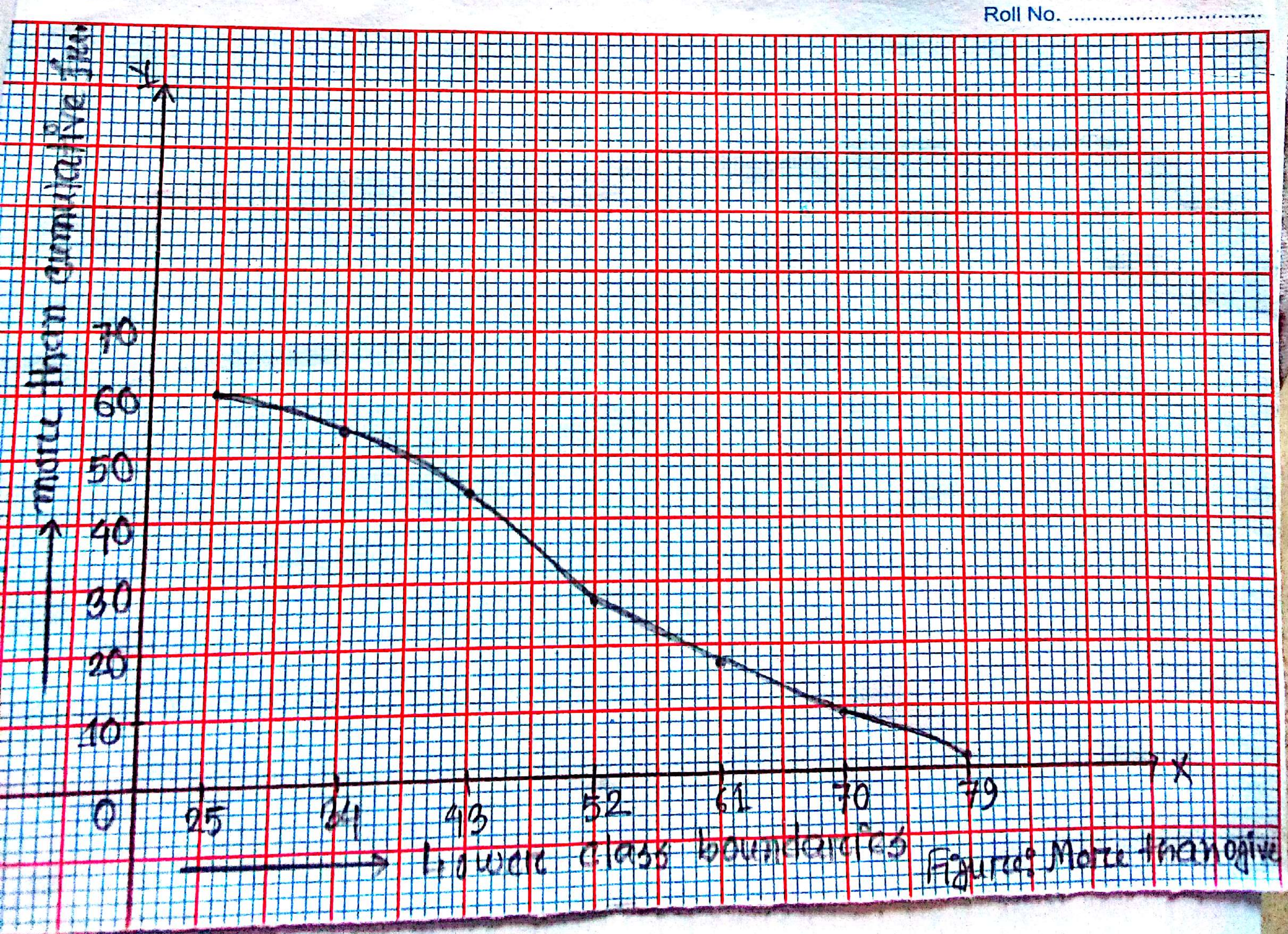


Figure: More than ogive

(ii) constructs relative frequency, percent relative frequency, cumulative frequency, percent relative cumulative frequency from the construct frequency table.

Solution: The relative frequency of a class is calculated by the Formula,

$$\text{Relative frequency of a class} = \frac{\text{Frequency of a class}}{\text{Total frequency}}$$

$$\text{Percent relative frequency} = \text{Relative frequency} \times 100$$

When frequency of a class is added with all frequencies before that class is called cumulative frequencies of that class.

$$\text{Relative cumulative frequency} = \frac{\text{Cumulative freq. of a class}}{\text{Total frequency}}$$

$$\text{Percent relative cumulative frequency} = \text{Relative cumu. frequency} \times 100$$

Relative percent and cumulative frequency table:

Class interval	Frequency	Relative frequency	Percent relative frequency	Cumulative frequency	Relative cumulative frequency	Percent relative cumulative frequency
25-34	6	0.1	10	6	0.1	10
34-43	10	0.2	20	16	0.267	26.7
43-52	17	0.22	22	33	0.55	55
52-61	10	0.2	20	43	0.72	72
61-70	8	0.13	13	51	0.85	85
70-79	7	0.12	12	58	0.97	97
79-88	2	0.03	3	60	1	1
	$n=60$	1	100			

(iii) Find the arithmetic mean of the original data.

Solution: From the original data,

the arithmetic mean $= \frac{\sum x_i}{n}$

where, n = Total number of observations

$\therefore$ A.M $= \frac{77+44+49+33+39+76+55+68+39+44+59+36+55+47+61+53+32+65+51+29+41+32+45+83+58+73+47+40+26+59+43+66+61+44+25+39+72+37+55+34+47+66+53+83+58+73+47+40+77+45+62+45+45+36+78+48+54+50+51+66}{60}$

$= 51.93$

$\therefore$ The arithmetic mean of the original data is 51.93

(iv) Find the arithmetic mean from the frequency table by direct and shortcut method.

Table for calculation:

Class interval	Frequency, (f_i)	Mid-point, (x_i)	$f_i x_i$	$d_i = \frac{x_i - A}{c}$, $A = 56.5$, $c = 9$	$f_i d_i$	c.f	$f_i \log x_i$	$\frac{f_i}{x_i}$
25–34	6	29.5	177	−3	−18	6	8.8189	0.2034
34–43	10	38.5	385	−2	−20	16	15.8546	0.2597
43–52	17	47.5	807.5	−1	−17	33	28.5038	0.3579
52–61	10	56.5	565	0	0	43	17.5205	0.1710
61–70	8	65.5	524	1	8	51	14.5299	0.1271
70–79	7	74.5	521.5	2	14	58	13.1051	0.0910
79–88	2	83.5	167	3	6	60	3.8434	0.0210
	$n = 60$		$\sum f_i x_i = 3147$		$\sum f_i d_i = -27$	-	$\sum f_i \log x_i = 102.1762$	$\sum \frac{f_i}{x_i} = 1.2261$

(i) Direct method: The formula for computing arithmetic mean by direct method is

$$\bar{x} = \frac{\sum f_i x_i}{n}$$

Here, x_i = mid-point of each class
f_i = frequency of each class
n = total number of observations

$$\therefore \bar{x} = \frac{\sum f_i x_i}{n} = \frac{3147}{60} = 52.45$$

That is, the arithmetic mean of 60 students of those are enrolled in a physics class is 52.45.

(ii) short-cut method: The formula for finding arithmetic mean by shortcut method is

$$\bar{x} = A + \frac{\sum f_i d_i}{n} \times c$$

Here, $d_i = \frac{x_i - A}{c}$

A = assumed mean

c = size of the class interval

we take $A = 56.5$ as it is in the middle most value of and $c = 9$ as the size of the class interval. We have $\sum f_i d_i = -27$, $n = 60$

so,
$$\bar{x} = A + \frac{\sum f_i d_i}{n} \times c$$
$$= 56.5 + \frac{-27}{60} \times 9$$
$$= 56.5 - 4.05$$
$$= 52.45$$

It is seen that both the methods give the same results but the shortcut method is easier than the direct method.

(v) Find geometric mean, harmonic mean, median and mode from the frequency table and also show that $AM \geq GM \geq HM$

Solution: We know that,

$$G.M = \text{Anti-log}\left(\frac{\sum f_i \log x_i}{n}\right)$$

From the frequency table of the previous solution we get $\sum f_i \log x_i = 102.1762$

$n = 60$

$\therefore$ G.M $= \text{Anti-log}\left(\frac{102.1762}{60}\right)$

$= \text{Anti-log}(1.70294)$

$= 50.46$

<u>Harmonic mean:</u>

We know that, $H.M = \frac{n}{\sum \frac{f_i}{x_i}}$

Also we get from the previous frequency table

$$\sum \frac{f_i}{x_i} = 1.2261$$

$$\therefore H.M = \frac{60}{1.2261}$$

$$= 48.94$$

Therefore, G.M = 50.46

H.M = 48.94

and from the previous solution we get,

A.M = 52.45

$\therefore$ A.M > G.M > H.M (Showed)

<u>Median:</u>

From the previous frequency table, $n = 60$, then $\frac{n}{2} = \frac{60}{2} = 30$th observation lies in the class 43-52. Hence the median class is 43-52.

Here $L = 43$, $\frac{n}{2} = 30$, $F = 16$, $f = 17$ and $c = 9$

$$\therefore M_e = L + \frac{\frac{n}{2} - F}{f} \times c$$

$$= 43 + \frac{30-16}{17} \times 9$$

$$= 43 + 7.412$$

$$= 50.412$$

Mode:

It is obvious from the frequency table that the class 43-52 contains the highest frequency. Hence the modal class is 43-52. The formula for finding mode is

$$M_o = L + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times c$$

Here, $L = 43$, $\Delta_1 = 17 - 10 = 7$, $\Delta_2 = 17 - 10 = 7$, $c = 9$

Hence, $M_o = L + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times c$

$= 43 + \frac{7}{7+7} \times 9$

$= 43 + 4.5$

$= 47.5$

Therefore, the modal test score received by students is 47.5

(vi) Locate median and mode graphically.

solution:

Locate median: Now plot the class limit on the x axis and the cumulative frequency on the y axis of the graph. Plot points above the class intervals according to their cumulative frequency. Join the points free hand to get the required ogive. Then locate a point $\frac{n}{2} = \frac{60}{2} = 30$ on the y axis and from this point draw a line parallel to the x axis on the ogive. Now draw perpendicular on the x-axis from the point at which the line cuts on the ogive. The point at which the perpendicular cuts the x-axis is the median. Here it is,

Mode 8

It is obvious from the frequency table that the class 43-52 contains the highest frequency. Hence the modal class is 43-52. The formula for finding mode is

$$M_o = L + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times c$$

Here, $L = 43$, $\Delta_1 = 17-10 = 7$, $\Delta_2 = 17-10 = 7$, $c = 9$

Hence, $M_o = L + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times c$

$$= 43 + \frac{7}{7+7} \times 9$$

$$= 43 + 4.5$$

$$= 47.5$$

Therefore, the modal test score received by students is 47.5

(vi) Locate median and mode graphically.

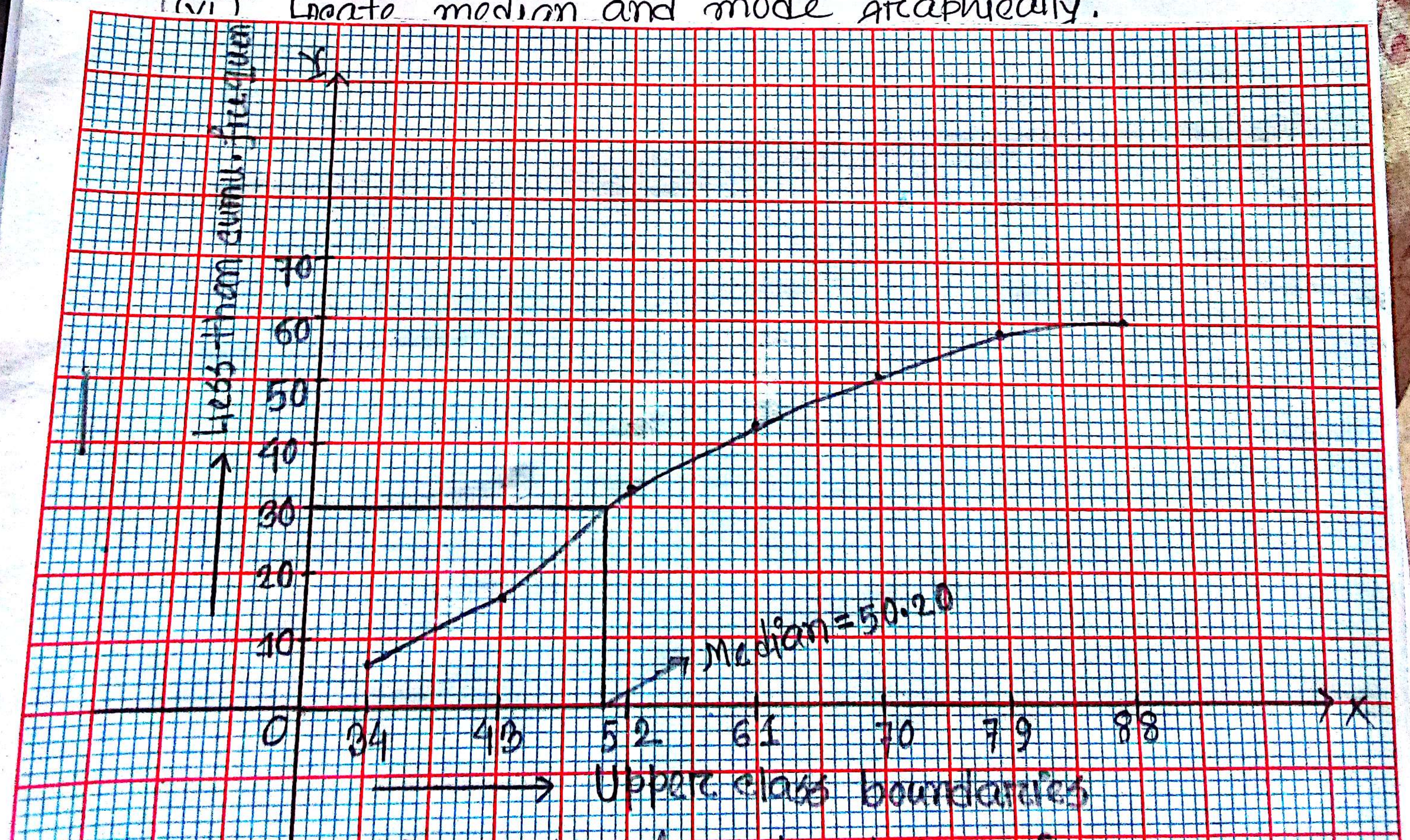
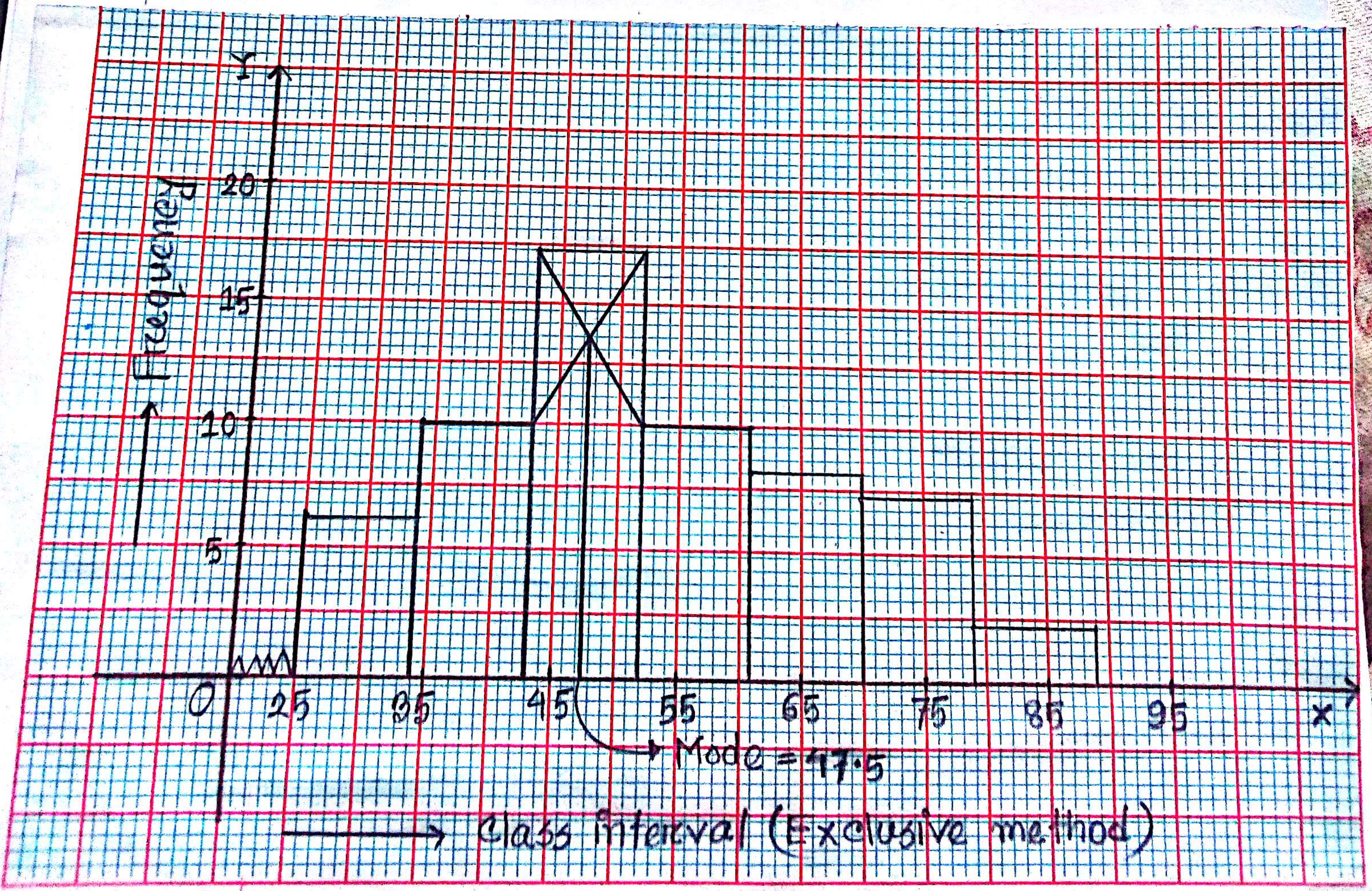


Fig: Median from less than ogive

Locate mode: Mode of a frequency distribution can be located graphically from a histogram. At first draw a histogram of the frequency distribution. Then locate modal class and the rectangle over this class by inspecting highest frequency. Then draw two lines diagonally on the inside of the modal class rectangle, starting from each upper corner of the adjacent rectangle. Draw a perpendicular line from the intersection of the two diagonal lines to the x-axis, which gives us modal value.



Roll No. ....

From the histogram it is seen that the mode is 47. We know that from the example 1(v) the mode of the distribution is 47.5. Hence by both the methods we get approximately the same value of mode.

(vii) Compute Q_1, Q_3, D_9, P_{10} and P_{99}.

<u>solution:</u> By using previous frequency table,

Here, we get, $n=60$

First quartile, Q_1 is the $\frac{n}{4}$ th ordered observation $= 15$th ordered observation. It lies in the class interval 34−43. The formula for Q_1 is

$$Q_1 = L_1 + \frac{\frac{n}{4} - F_1}{f_1} \times c_1$$

Here, $L_1 = 34$, $\frac{n}{4} = 15$, $F_1 = 6$, $f_1 = 10$, $c_1 = 9$

$$\therefore Q_1 = 34 + \frac{15-6}{10} \times 9$$

$$= 34 + \frac{9}{10} \times 9$$

$$= 42.1$$

Third quartile, Q_3 is the $\frac{3n}{4}$ th ordered observation $= 45$th ordered observation. It lies in the class 61−70. Third quartile Q_3 is

$$Q_3 = L_3 + \frac{\frac{3n}{4} - F_3}{f_3} \times c_3$$

Here, $L_3 = 61$, $\frac{3n}{4} = 45$, $F_3 = 43$, $f_3 = 8$, $c_3 = 9$

$$\therefore Q_3 = 61 + \frac{45-43}{8} \times 9$$

$$= 61 + \frac{2}{8} \times 9$$

$$= 63.25$$

Scanned by CamScanner

Nineth decile, D_9 is the $\left(\frac{9n}{10}\right)$th ordered observation $= \frac{9 \times 60}{10} = 54$th ordered observation. It lies in the class 70–79.

$$\therefore D_9 = L_9 + \frac{\frac{9n}{10} - F_9}{f_9} \times c_9$$

Here, $L_9 = 70$, $\frac{9n}{10} = 54$, $F_9 = 51$, $f_9 = 7$, $c_9 = 9$

Hence, $D_9 = 70 + \frac{54 - 51}{7} \times 9$

$= 73.857$

Tenth percentile, P_{10} is the $\left(\frac{10n}{100}\right)$th ordered observation $= \left(\frac{10 \times 60}{100}\right) = 6$th ordered observation. Sixth observation lies in the class 25–34. Hence, $P_{10} = L_{10} + \frac{\frac{10n}{100} - F_{10}}{f_{10}} \times c_{10}$

Here, $L_{10} = 25$, $\frac{10n}{100} = 6$, $F_{10} = 0$, $f_{10} = 6$, $c_{10} = 9$

$$\therefore P_{10} = L_{10} + \frac{\frac{10n}{100} - F_{10}}{f_{10}} \times c_{10}$$

$$= 25 + \frac{6-0}{6} \times 9$$

$$= 34$$

Ninetyninth percentile, P_{99} is the $\left(\frac{99n}{100}\right)$th ordered observation $= \frac{99 \times 60}{100} = 59.4$th observation.

Ninetynineth observation lies in the class 79–88.

Hence, $P_{99} = L_{99} + \frac{\frac{99n}{100} - F_{99}}{f_{99}} \times c_{99}$

Here, $L_{99} = 79$, $\frac{99n}{100} = 59.4$, $F_{99} = 58$, $f_{99} = 2$, $c_{99} = 9$

$$\therefore P_{99} = L_{99} + \frac{\frac{99n}{100} - F_{99}}{f_{99}} \times c_{99}$$

$$= 79 + \frac{59.4 - 58}{2} \times 9$$

$$= 85.3$$

(viii) From frequency distribution calculate
(a) quartile deviation
(b) standard deviation and
(c) coefficient of variation

Solution:

(a) Quartile deviation is computed by the following formula, $Q.D = \frac{Q_3 - Q_1}{2}$

from the above solution, we get,

$Q_1 = 42.1$ and $Q_3 = 63.25$

Hence, $Q.D = \frac{Q_3 - Q_1}{2}$

$$= \frac{63.25 - 42.1}{2}$$

$$= 10.575$$

(b) We know that,

variance, $s^2 = \frac{\sum f_i x_i^2}{n} - \left(\frac{\sum f_i x_i}{n}\right)^2$

and, $S.D = \sqrt{s^2} = s$

Table for calculation :-

class interval	Frequency (f_i)	Mid-value (x_i)	$f_i x_i$	$f_i x_i^2$
25-34	6	29.5	177	5221.5
34-43	10	38.5	385	14822.5
43-52	17	47.5	807.5	38356.25
52-61	10	56.5	565	31922.5
61-70	8	65.5	524	34322
70-79	7	74.5	521.5	38851.75
79-88	2	83.5	167	13944.5
	$n = 60$		$\Sigma f_i x_i = 3147$	$\Sigma f_i x_i^2 = 177441$

Hence, $s^2 = \dfrac{\Sigma f_i x_i^2}{n} - \left(\dfrac{\Sigma f_i x_i}{n}\right)^2$

$= \dfrac{177441}{60} - \left(\dfrac{3147}{60}\right)^2$

$= 2957.35 - 2751.0025$

$= 206.3475$

and, standard deviation, $S.D = \sqrt{s^2}$

$= \sqrt{206.3475}$

$= 14.37$

(c) We know that,

Coefficient of variation, $c.v = \frac{s}{\bar{x}} \times 100$

where, $\bar{x} = \frac{\sum f_i x_i}{n}$

$n = \sum f_i$

Hence, $\bar{x} = \frac{\sum f_i x_i}{n}$

$= \frac{3147}{60}$

$= 52.45$

$s = 14.37$

Therefore, co-efficient of variation, $c.v = \frac{14.37}{52.45} \times 100$

$= 27.40\%$.

$\mu_1 = 0$

$$\mu_2 = \mu_2' - (\mu_1')^2$$

$$= 222.75 - (-4.05)^2$$

$$= 206.3475$$

$$\mu_3 = \mu_3' - 3\mu_2'\mu_1' + 2(\mu_1')^3$$

$$= -1713.15 - 3(222.75)(-4.05) + 2(-4.05)^3$$

$$= 860.40225$$

$$\mu_4 = \mu_4' - 4\mu_3'\mu_1' + 6\mu_2'(\mu_1')^2 - 3(\mu_1')^4$$

$$= 103335.75 - 4(-1713.15)(-4.05) + 6(222.75)(-4.05)^2 - 3(-4.05)^4$$

$$= 96697.53523$$

We know,

$$\beta_1 = \frac{\mu_3^2}{\mu_2^3}$$

$$= \frac{(860.40225)^2}{(206.3475)^3}$$

$$= 0.0842$$

and, $\beta_2 = \frac{\mu_4}{\mu_2^2}$

$$= \frac{96697.53523}{(206.3475)^2}$$

$$= 2.27$$

(ix) From frequency distribution compute four central moments, β_1 and β_2.

Solution:

Table for calculation

class interval	Frequency (f)	Mid-point (x)	$d=\frac{x-A}{i}$ $A=56.5$, $i=9$	fd	fd^2	fd^3	fd^4
25–34	6	29.5	-3	-18	54	-162	486
34–43	10	38.5	-2	-20	40	-80	160
43–52	17	47.5	-1	-17	17	-17	17
52–61	10	56.5	0	0	0	0	0
61–70	8	65.5	1	8	8	8	8
70–79	7	74.5	2	14	28	56	112
79–88	2	83.5	3	6	18	54	162
Total	$n=60$		0	-27	165	-141	945

Calculation for central moments:

$$\mu_1' = \frac{\Sigma fd}{n} \times i = \frac{-27}{60} \times 9 = -4.05$$

$$\mu_2' = \frac{\Sigma fd^2}{n} \times i^2 = \frac{165}{60} \times 9^2 = 222.75$$

$$\mu_3' = \frac{\Sigma fd^3}{n} \times i^3 = \frac{-141}{60} \times (9)^3 = -1713.15$$

$$\mu_4' = \frac{\Sigma fd^4}{n} \times i^4 = \frac{945}{60} \times (9)^4 = 103335.75$$

Scanned by CamScanner

Q.2 The following data gives the expenditure budget in core taka of different sector of a country for the financial year 2005.

Sector	Agricul-ture	Industry	Educat-ion	Trans-port	Others	Total
Expenditure budget	80	70	40	25	55	270

Construct, a pie chart and bar diagram with the above data.

Solution 8

The relative expenditures, percent expenditures and angle of different sectors are calculated by the following formula

$$\text{Relative expenditure} = \frac{\text{Expenditure of any sector}}{\text{Total expenditure}}$$

$$\text{Percent expenditure} = \text{Relative expenditure} \times 100$$

The angle of a sector can be computed by the following formula.

$$\text{Angle} = \text{Relative expenditure} \times 360^\circ$$

The relative expenditures, percent expenditures and angle of different sectors are shown in the following table:

Sector	Expenditure	Relative Expenditure	Percent Expenditure	Angles of different sectors in degree
Agriculture	80	0.30	29.63	108.00
Industry	70	0.26	25.93	93.60
Education	40	0.15	14.81	54.00
Transport	25	0.09	9.26	32.40
Others	55	0.20	20.37	72.00
Total	270	1.00	100.00	360

The bar diagram for the above data can be constructed by plotting the expenditure of different sectors in the vertical axis and different sectors in the horizontal axis. The bar diagram is shown in the following figure.

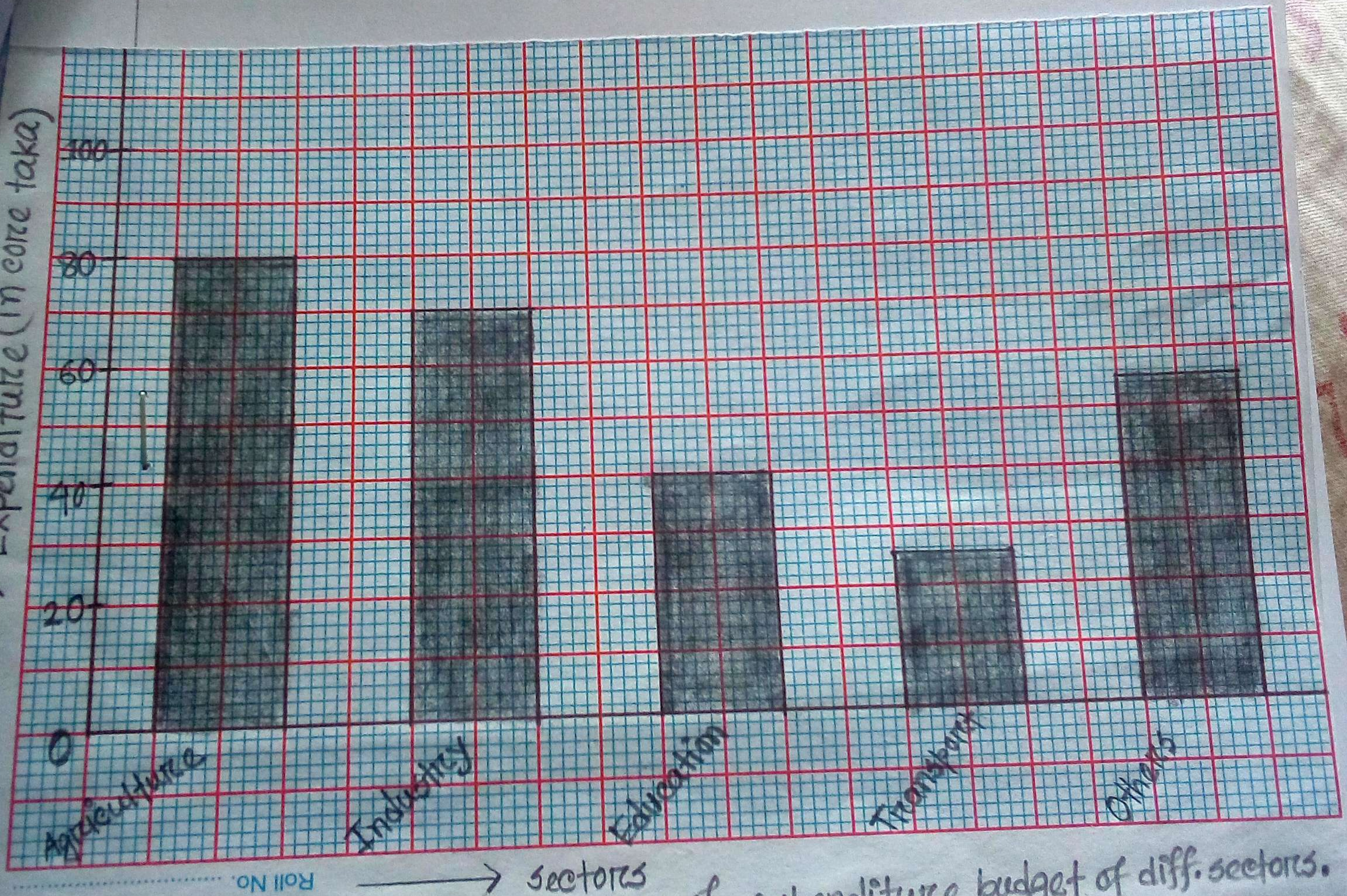


Figure: Bar diagram of expenditure budget of diff. sectors.

Q.1 The following data give the blood pressure of 10 women:

Age	56	42	36	47	49	42	60	72	63	55
Blood Pressure	147	125	118	128	145	140	155	160	149	150

(i) Determine the co-efficient of co-relation between age and blood pressure and also comment for the result.

(ii) Determine the coefficient of determination and interpret.

(iii) Is the value of 'r' is significant or not?

(iv) Fit regression line of blood pressure and age.

(v) Estimate the blood-pressure of women whose age is 45 years.

<u>solution:</u> Table for calculation:

Age (X)	Blood pressure (Y)	XY	X^2	Y^2
56	147	8232	3136	21609
42	125	5250	1764	15625
36	118	4248	1296	13924
47	128	6016	2209	16384
49	145	7105	2401	21025
42	140	5880	1764	19600
60	155	9300	3600	24025
72	160	11520	5184	25600
63	149	9387	3969	22201
55	150	8250	3025	22500
$\Sigma X = 522$	$\Sigma Y = 1417$	$\Sigma XY = 75188$	$\Sigma X^2 = 28348$	$\Sigma Y^2 = 202493$

(i) We know that,

Co-efficient of co-relation,

$$r = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{n}}{\sqrt{\left\{\Sigma X^2 - \frac{(\Sigma X)^2}{n}\right\}\left\{\Sigma Y^2 - \frac{(\Sigma Y)^2}{n}\right\}}}$$

$$= \frac{75188 - \frac{522 \times 1417}{10}}{\sqrt{\left\{28348 - \frac{(522)^2}{10}\right\}\left\{202493 - \frac{(1417)^2}{10}\right\}}}$$

$$= \frac{1220.6}{\sqrt{1099.6 \times 1704.1}}$$

$$= 0.892$$

Comment: Since $r = 0.892$, so their is strong positive relationship between age and blood pressure.

Scanned by CamScanner

(ii) We know that,

co-efficient of determination $= r^2$

$= (0.892)^2$

$= 0.795664$

≈ 0.8

Comment : 80% of the total variation in the dependent variable has been explained by the independent variable.

(iii) We know that,

If $r > 6 P.E$; then the value of r is significant.

Now, $P.E = 0.6745 \times S.E_{(r)}$

Here, $S.E_{(r)} = \dfrac{1 - r^2}{\sqrt{n}}$

$= \dfrac{1 - (0.892)^2}{\sqrt{10}}$

$= 0.0646$

$\therefore$ $P.E = 0.6745 \times 0.0646$

$= 0.0436$

Now, $6 \times P.E = 6 \times 0.0436$

$= 0.2616$

Comment : Since $r > 6 P.E$; then the value of r is significant.

(iv) Let, $x =$ age
$Y =$ blood pressure

Again, the regression line of Y on x is

$$Y = a + bx$$

Here, $$\hat{b} = \frac{\sum xY - \frac{\sum x \sum Y}{n}}{\sum x^2 - \frac{(\sum x)^2}{n}}$$

$$= \frac{75188 - \frac{522 \times 1417}{10}}{28348 - \frac{(522)^2}{10}}$$

$$= \frac{1220.6}{1099.6}$$

$$= 1.1$$

and $\hat{a} = \bar{Y} - \hat{b}\bar{x}$

$$= 141.7 - 1.1 \times 52.2$$

$$= 141.7 - 57.42$$

$$= 84.28$$

$\therefore Y = 84.28 + 1.1x$

Here,

$$\bar{Y} = \frac{\sum Y}{n} = \frac{1417}{10} = 141.7$$

$$\bar{x} = \frac{\sum x}{n} = \frac{522}{10} = 52.2$$

(v) We have to find out the blood pressure whose age is 45 years

so, $x = 45$

We know that, $Y = a + bx$

$$= 84.28 + 1.1 \times 45$$

$$= 84.28 + 49.5$$

$$\therefore Y = 133.78$$

Hence, the blood pressure is 133.78

Q.2 Quotations of index no. of equity shares prizes of a certain Jaint stock company & of prizes of preference share are given below:

Year	1999	2000	2001	2002	2003	2004	2005
Equity share	97.5	99.4	98.6	96.2	95.1	98.4	97.1
Preference share	75.1	75.9	77.1	78.2	79.0	74.8	76.2

(i) Use the method of rank co-relation determine the relationship between Equity share and Preference share.

Scanned by CamScanner

solution: Table for calculation:

Year	Equity share	Preference share	Rank of Equity share (R_1)	Rank of Preference share (R_2)	$d_i^2 = (R_1-R_2)^2$
1999	97.5	75.1	4	6	4
2000	99.4	75.9	1	5	16
2001	98.6	77.1	2	3	1
2002	96.2	78.2	6	2	16
2003	95.1	79.0	7	1	36
2004	98.4	74.8	3	7	16
2005	97.1	76.2	5	4	1
					$\Sigma d_i^2 = 90$

We know that,

Rank co-relation, $R = 1 - \frac{6 \Sigma d_i^2}{n(n^2-1)}$

Here, $n=7$

$\therefore R = 1 - \frac{6 \times 90}{7(7^2-1)}$

$= 1 - \frac{540}{336}$

$\therefore R = -0.607$

Q.3

X	70	72	75	75	68	60
Y	12	13	14	14	14	11

(i) calculate the Rank co-relation of co-efficient from the above following data.

Solution: Table for calculation:

X	Y	Rank of X (R_1)	Rank of Y (R_2)	$d_i^2 = (R_1 - R_2)^2$
70	12	4	5	1
72	13	3	4	1
75	14	1.5	2	0.25
75	14	1.5	2	0.25
68	14	5	2	9
60	11	6	6	0
				$\Sigma d_i^2 = 11.50$

Since there is repeated value; so whenever we were counting rank of X, it becomes start 1.5, 1.5, 3, 4, 5, 6 respectively and $\frac{1+2}{2} = 1.5$; rank of Y $= \frac{1+2+3}{3} = 2$

We know that,

$$R = 1 - \frac{6\left\{\Sigma d_i^2 + \frac{1}{12}\sum_{i=1}^{n}(m_i^3 - m_i)\right\}}{n(n^2-1)}$$

Scanned by CamScanner

In series X ; 75 had come two times i.e, $m_1 = 2$
and in series Y ; 14 had come three times i.e, $m_2 = 3$

∴ Rank co-relation coefficient,

$$R = 1 - \frac{6\left\{11.5 + \frac{1}{12}(2^3-2) + \frac{1}{12}(3^3-3)\right\}}{6(36-1)}$$

$= 1 - 0.4$
$= 0.6$

Comment: since $R = 0.6$; therefore, there is moderate degree of positive relationship between X and Y.

Q.4 A survey was conducted by manufacturing company to enqure the maximum prize at which person would be willing to buy their product. The following table gives stated prize (tk) by persons.

Prize (in taka)	80-90	90-100	100-110	110-120	120-130
No. of person	11	29	18	27	15

(i) Calculate the first four central moments from the above frequency distribution and obtain β_1, β_2 and comment of the nature of the distribution.

(ii) Calculate Karl Pearson coefficient of skewness from the above frequency distribution.

Solution: (i) Table for calculation:

Class interval,	Frequency (f)	Mid-point (x)	$d=\frac{x-A}{i}$ $A=105$ $i=10$	fd	fd^2	fd^3	fd^4
80-90	11	85	-2	-22	44	-88	176
90-100	29	95	-1	-29	29	-29	29
100-110	18	105	0	0	0	0	0
110-120	27	115	1	27	27	27	27
120-130	15	125	2	30	60	120	240
Total	$n=100$		0	6	160	30	472

Calculation for central moments:

$$\mu_1' = \frac{\Sigma fd}{n} \times i = \frac{6}{100} \times 10 = 0.6$$

$$\mu_2' = \frac{\Sigma fd^2}{n} \times i^2 = \frac{160}{100} \times (10)^2 = 160$$

$$\mu_3' = \frac{\Sigma fd^3}{n} \times i^3 = \frac{30}{100} \times (10)^3 = 300$$

$$\mu_4' = \frac{\Sigma fd^4}{n} \times i^4 = \frac{472}{100} \times (10)^4 = 47200$$

Scanned by CamScanner

$\therefore \mu_1 = 0$

$$\mu_2 = \mu_2' - (\mu_1')^2$$
$$= 160 - (0.6)^2$$
$$= 159.64$$

$$\mu_3 = \mu_3' - 3\mu_2'\mu_1' + 2(\mu_1')^3$$
$$= 300 - 3 \times 160 \times 0.6 + 2(0.6)^3$$
$$= 300 - 288 + 0.432$$
$$= 12.432$$

$$\mu_4 = \mu_4' - 4\mu_3'\mu_1' + 6\mu_2'(\mu_1')^2 - 3(\mu_1')^4$$
$$= 47200 - 4 \times 300 \times 0.6 + 6 \times 160 \times (0.6)^2 - 3 \times (0.6)^4$$
$$= 47200 - 720 + 345.6 - 0.3888$$
$$= 46825.2112$$

Hence, $\beta_1 = \frac{\mu_3^2}{\mu_2^3}$

$$= \frac{(12.432)^2}{(159.64)^3}$$
$$= 0.00004$$

and, $\beta_2 = \frac{\mu_4}{\mu_2^2}$

$$= \frac{46825.2112}{(159.64)^2}$$
$$= 1.83$$

Comment: Since μ_3 is positive and β_1 is also positive. The curve is positively skewed. The value of β_2 is less than 3, so the curve is platykurtic.

(ii) Table for calculation:

Class interval	Frequency (f_i)	Mid-point (x_i)	$f_i x_i$	$f_i x_i^2$
80 - 90	11	85	935	79475
90 - 100	29	95	2755	261725
100 - 110	18	105	1890	198450
110 - 120	27	115	3105	357075
120 - 130	15	125	1875	234375
Total	$n = \Sigma f_i = 100$		$\Sigma f_i x_i = 10560$	$\Sigma f_i x_i^2 = 1131100$

We know that, Karl Pearson co-efficient of skewness,

$$C.S.K = \frac{\text{Mean} - \text{Mode}}{S.D}$$

Here, mean, $\bar{x} = \frac{\Sigma f_i x_i}{n}$

$$= \frac{10560}{100}$$

$$= 105.6$$

Mode, $M_o = L + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times c$

From the above frequency table the class 90-100 contains the haighest frequency. Hence, the modal class is 90-100.

Here, $L = 90$, $\Delta_1 = 29 - 11 = 18$, $\Delta_2 = 29 - 18 = 11$, $c = 10$

$$\therefore \quad M_0 = 90 + \frac{18}{18+11} \times 10$$
$$= 90 + 6.207$$
$$= 96.207$$

and, $$S.D = \sqrt{\frac{\Sigma f_i x_i^2}{n} - \left(\frac{\Sigma f_i x_i}{n}\right)^2}$$
$$= \sqrt{\frac{1131100}{100} - \left(\frac{10560}{100}\right)^2}$$
$$= \sqrt{11311 - 1151.36}$$
$$= \sqrt{159.64}$$
$$= 12.63$$

$$\therefore \quad C.S.K = \frac{\text{Mean} - \text{Mode}}{S.D}$$
$$= \frac{105.6 - 96.207}{12.63}$$
$$= 0.7437$$

Therefore, the Karl Pearson co-efficient of skewness is 0.7437.

Scanned by CamScanner